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Optimization of antioxidant compounds extraction from feijoa (*Acca sellowiana berg*) residues

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Abstract

Feijoa residues has a high content of bioactive compounds with effective antioxidant activity compared with the content of other fruits. However, these wastes are disposed of without generating added value. Therefore, in order to determine the maximum time to extract the polyphenols (TPC) and flavonoids (TFC) present in the residue, solid-liquid extraction kinetics was performed. Next, in order to find the best conditions for maximizing the simultaneous extraction of TPC and TFC, a central composite design and response surface analysis were proposed. Three independent factors, temperature (ranging from 13.18 to 46.82 °C), solid:liquid ratio (ranging from 1:10 to 1:74 g:mL) and ethanol-water mixture (ranging from 16,36 to 83,64%v/v) were evaluated. The kinetics indicated a maximum extraction time of 90 minutes for TPC with 3,990.02 ± 22.403 mgGAE/100 g FW, and 45 minutes for TFC with 1,219.38 ± 19.24 mgCE/100 g FW. These values are within the range reported by other studies using advanced technology. The optimized extraction conditions were a temperature of 34.5 °C, 1:45 solid-liquid ratio and 39.43% for the solvent. Finally, extract from feijoa residues presented an effective antioxidant activity greater than 50%. Therefore, this residue can be used as a promising source of bioactive compounds with various agro-industrial applications.

Keywords: feijoa; extraction; polyphenols; flavonoids; antioxidant.

Practical Application: Feijoa residues can be used to produce extracts with a high content of bioactive compounds with effective antioxidant activity.

1 Introduction

Feijoa is a native fruit of South America that is grown in Brazil, Paraguay, Colombia, as well as New Zealand, and the United States due to its attractive organoleptic attributes (Sánchez-Riaño et al., 2020; Zhu, 2018). During the commercialization and processing of this fruit in supply centers and processing industries a large amounts of residue is generated. The main residue generated is the peel of feijoa because it represents around 50% of the fruit's weight (Santos et al., 2019; Tuncel & Yılmaz, 2015). Feijoa peel has a high content of bioactive compounds with effective antioxidant activity, such as polyphenols, flavonoids, and vitamins compared with other tropical fruits (Amarante et al., 2017; Sun-Waterhouse et al., 2013; Weston, 2010). This residue could be used to obtain bioactive compounds of interest for food, pharmaceutic, and nutraceutical industries (Liakou et al., 2018; Pasquariello et al., 2015; Sánchez-Riaño et al., 2020). These compounds include polyphenols such as ellagic, ferulic, gallic and caffeic acid derivatives, and flavonoids, for instance, isoquercetin, catechin, and rutin, which have been proposed to have antioxidant, anticancer and anti-inflammatory properties (Almeida et al., 2020; Peng et al., 2019; Schmidt et al., 2020). In order to obtain bioactive compounds, different traditional extraction techniques are used, such as Soxhlet extraction technology, which presents difficulties associated with long extraction time and high solvent and energy consumption (Ameer et al., 2017; Azmir et al., 2013; Vallejo-Castillo et al., 2020a). Conversely, other extraction techniques can reduce time and solvent consumption, such as ultrasonic, microwave, or supercritical fluid-assisted extraction (Aliakbarian et al., 2012; Chan et al., 2011; Vallejo-Castillo et al., 2020b), however, assisted extractions have the disadvantages of high initial investment and the difficulty of scaling up (Chemat et al., 2017; Watson, 2014). Orbital shaking extractions with green solvents such as water and ethanol, have been used to obtain bioactive compounds from different vegetables residues to achieve high levels of polyphenols and flavonoids with effective antioxidant activity. In addition, this type of extraction is cost-effective, scalable, and economically feasible (Castillo-Santos et al., 2017; Ilaiyaraja et al., 2015; Ochoa-Velasco et al., 2019). The techniques used to extract these compounds are affected by parameters related to solvent polarity, temperature, time, and solid-solvent ratio. Consequently, optimization strategies are used in order to reduce time, energy consumption, and increase the recovery of bioactive compounds with high antioxidant activity. The most used methodologies for this optimization are the experimental design of a response surface and a multiple response optimization (Bezerra et al., 2019; Gomes et al., 2013; Rajha et al., 2014).

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